STPA Industrialization / Adoption in Industry
(Thoughts and Perspectives - 2021)

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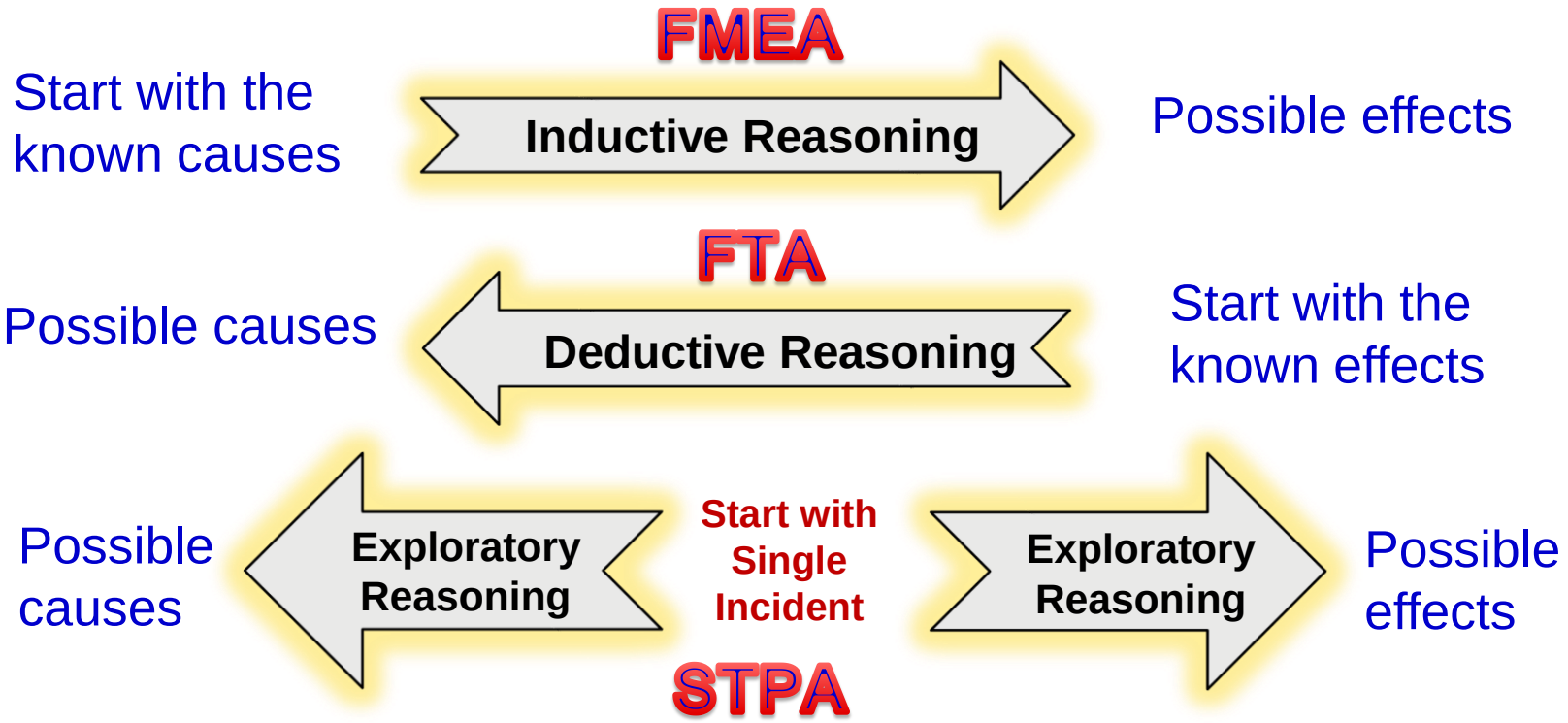
STPA Industrialization and Adoption in Industry

- Past presentations summarized observations made by writer
  - Initial introduction activities
  - Finding an initial application for STPA
  - Demonstrating value of STPA and validating STPA usefulness
  - STPA and other system safety analysis methodologies
  - STPA evaluation effort
  - Effort to educate system safety engineers
  - Expansion of STPA usage beyond initial niche
  - Potential future areas of STPA usage

STPA Industrialization and Adoption in Industry - Review



STPA Industrialization and Adoption in Industry - Review

		Causes: Unknown	Causes: Known
Effects	Unknown	*Exploratory Analysis*	*Inductive Analysis*
	Known	*Deductive Analysis*	*Descriptive Analysis*

- Deductive Analysis (e.g., FTA)
- Inductive Analysis (e.g., FMEA, Interface Analysis)
- Exploratory Analysis (e.g., HAZOP, what-if, STPA)
- Descriptive Analysis (e.g., straight forward observations)

STPA Industrialization and Adoption in Industry – Risk Management

Perspectives and attitudes that might be present:

- Groups who think system safety is an impediment to progress and just there to make things hard. They will not understand why there is concern as “we are using off the shelf components, and they are obviously safe as they are available on the web.”
- Groups who think the system provided needs to manage any, and all, potential hazard risk. The program or marketing teams just need to understand this and stop complaining about having to implement system safety requirements.
- Groups who have no, or limited, human factors or human behavior experiences and think that operators of the system will be fine dealing with any misbehaviors without issues
- Groups who think customers should know what they are buying or using as risks are self-evident

STPA Industrialization and Adoption in Industry –Risk Management

These issues of understanding need to be addressed through continuous joint work between all participants involved in the system program.

One method that has proven useful to educate people is to explain that requirements are needed to prevent or minimize causes or reasons that could lead to unwanted action which may produce hazards where risk is present, that may result in mishaps.

STPA Industrialization and Adoption in Industry –Risk Management

In virtually of these discussions, individuals will understand the reason for having system safety requirements, as they are a means to manage potential risks. Engineers do not want the system they design and deliver to cause harm, or to not attain the desired goals.

J-3187 - SAE STPA Recommended Practices

Planned Release Late Q3 2021

Task Force has created Working Groups and Topics:

- Group 1 – Basic STPA Approach, Recommended Practices, Lessons Learned
- Group 2 – SOTIF and STPA
- Group 2 – HMI and STPA
- Group 2 – MBSE and STPA
- Group 3 –High Level Use of STPA within Safety Process & STPA with Other Safety Evaluation Methods
- Examples – Aerospace, Automotive, Automotive HMI, MBSE, SOTIF
- Glossary

Backup

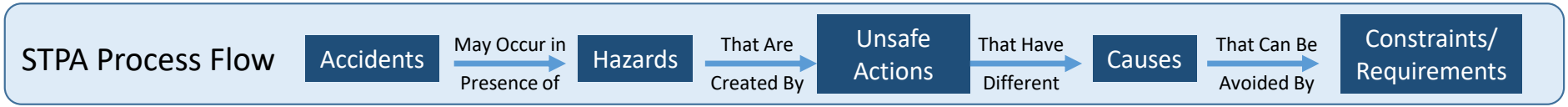
STPA Industrialization and Adoption in Industry

- Comparison of STPA to other safety analysis methodologies
  - Need to choose your “spectrum” philosophy

  - Consider how much effort needed to get rid of other methodologies and if organization would even entertain that idea
  - STPA is an “exploratory” to complement “inductive” (FMEA) and “deductive” (FTA) evaluation methodologies
  - Consider how STPA would/could feed or flow into other methods
  - Emphasize STPA can be very effective in finding missing requirements especially early in concept phase on systems
  - STPA strong for “non-failure” controls-based system design evaluations

Integration of STPA into GM Safety Process – Shift by Wire Example

- *Understanding requirements linkage to potential hazardous states allowed "Design Center" teams to accommodate safety requirements (data driven)*

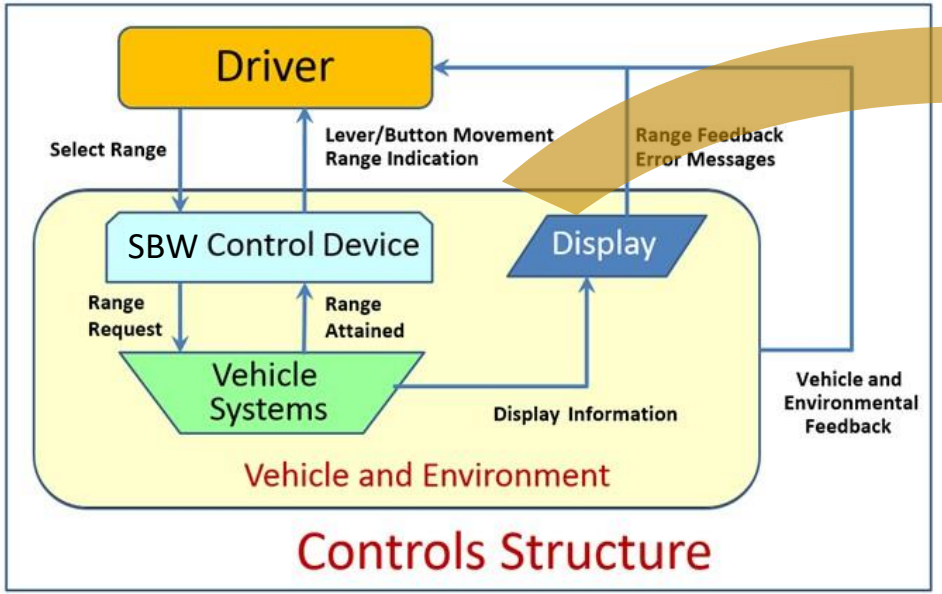


STPA derived requirements GMC Terrain Push-Button design:

- *Different motions to obtain Drive or Reverse versus Neutral or Park*
- *Pull buttons for any propulsion range selection (Reverse and Drive)*
- *One motion (push to get easily to Park or to Neutral)*
- *Buttons laid out in familiar, expected pattern (PRNDL)*
- *Buttons do not latch, instead are mono-stable*
- *Software content to manage inappropriate shift requests while at speed*
- *Auto-park capability if vehicle not placed in Park when required*

Integration of STPA into GM Safety Process – Shift by Wire Example

Define system content (control structure) and the interactions between the driver and the system



STPA ACTIVITIES

Determine possible causal scenarios that could result in any UCA

37 UCAs Defined

100 Potential Causal Scenarios Defined

UCA	Potential C
UCA1: Driver does not put car in Park on hill	Driver is distracted, or in a panic mode, or is rushing to decide to get into park
UCA1: Driver does not put car in Park on hill	Driver already thinks the car is in Park because of a previous action
UCA1: Driver does not put car in Park on hill	Driver thinks it is already in Park because belief the vehicle will do it automatically
UCA1: Driver does not put car in Park on hill	Driver cannot find Park
UCA1: Driver does not put car in Park on hill	Driver performs prior habitual actions leads to not selecting Park in this vehicle (Prior Learned Behavior)
UCA1: Driver does not put car in Park on hill	System feedback is confusing to driver

STPA ACTIVITIES

Condense functional and design constraints into requirements

Meets FMVSS Requirements 101, 102, and 114
Buttons, Knobs, Levers Must Be "Mono-Stable" (momentary activation)
Brake, plus two motions, necessary to exit Park; P => N (Safe)
One motion from D => N (Easy)
Two Motions to get to Reverse from any "Drive" gear (D,L,M)
Controls are clearly identified and obvious, easily accessible
Park button easy to find

Incorporation of STPA Requirements into Appropriate Sub-System and Component Specification Documents And into Design Center “Best Practices”

STPA Industrialization and Adoption in Industry

- Initial Introduction Activities
  - Bring back STPA information from conferences/symposiums to your organization
  - Attend MIT STPA Workshops or review presentations from MIT PSAS site
  - Be open minded
  - Perform internal review of your own safety process
  - Assess possible usefulness

STPA Industrialization and Adoption in Industry

- Tips for success
  - First and foremost - Make sure there is a need STPA can fill (i.e., HMI – socio technical benefits)
  - Don’t try to change the whole world . . .
    - The goal should be not to solve world hunger, but just to feed the family[1]
  - Maintain your vision . . . but be ready to modify based on good feedback or input
  - Leverage idea of continuous improvement for existing processes by enhancing use of systems engineering and systems thinking . . .
  - Talk to other people inside and outside of your organization . .

[1] G. Ressler – GM Tech Fellow

STPA Industrialization and Adoption in Industry

- Finding an initial application for STPA
  - Learn STPA to a working level
  - Look for an area with the greatest need
  - Propose STPA as an alternative to struggling methodology
    - Used STPA as alternative to a DFMEA effort to deal with human factors
  - Operate below the “radar”
    - Be focused
    - Do not alienate people with grandiose statements
    - Be respectful of people’s concerns

STPA Industrialization and Adoption in Industry

- Demonstrating value of STPA
  - Review results with program team
  - Demonstrate traceability logic
  - Emphasize STPA's use of causal scenarios
    - Do not need physical failures to have potential hazard
  - Test usefulness by assessing acceptance/rejection by program team
  - Test usefulness by evaluation how STPA supplements existing "standards" or processes
    - ISO 26262
    - ISO PAS 21444 (SOTIF)

STPA Industrialization and Adoption in Industry

- STPA evaluation effort
  - Emphasize STPA provides straightforward methodology to assess designs and define requirements necessary to prevent or manage hazard
  - STPA can be used instead of other evaluation methods
    - HMI – STPA worked better than FMEA to deal with causal scenarios
    - Electric Power Steering – STPA provided requirements at multiple levels more efficiently than system element fault analysis did (use abstraction)
  - STPA can save effort by substituting or supplementing for current evaluations methods or by filling a role for a missing evaluation.
  - Take time to work 1-on-1 with groups to educate them on STPA opportunities

STPA Industrialization and Adoption in Industry

- Effort to educate system safety engineers
  - STPA as a recognized part of internal system safety process
  - Develop educational collateral to be used by SSE
    - Training sessions
    - Documents explaining and providing examples, examples, examples (did I say “examples”?)
    - Hands on sessions
  - Find willing practitioners
  - Leverage system engineering and system thinking

STPA Industrialization and Adoption in Industry

- Expansion of STPA usage beyond initial application
  - Integrate STPA as part of expected process(es)
  - Apply STPA to applications of HMI and complex programs
  - Relentless, respectful, enthusiastic support without alienating people
  - Find respected person/people to be STPA proponents
  - Incorporate STPA generated requirements into corporate requirement documents and specifications
  - Seek out like-minded STPA practitioners in your industry or across industries to find common interests and needs
    - SAE STPA Recommended Practices Task Force

STPA Industrialization and Adoption in Industry

- Expansion of STPA usage beyond initial application
  - Demonstrate value of STPA requirements for safety concerns
  - Associate STPA with corporate initiatives when it helps Leverage systems engineering and system thinking
  - Use on programs with new functions and features that have not been implemented yet or implemented together yet
  - Gather objective data showing results
    - Requirements generated
    - Design updates and changes driven by STPA evaluations
    - Short time to get results

Integration of STPA into GM System Safety Process

- *Why Do This?*
  - *ISO26262 does not sufficiently address the evaluation of human behavior as part of its process as thoroughly as GM desires for HMI*
  - *This is an instance of the GM strategy to incorporate the “best of the best” from system safety sources outside of GM*

Integration of STPA into GM Safety Process – Shift by Wire Example

Integrating STPA in Large Organizations

- Potential future areas of STPA usage
  - More HMI evaluations
  - Complex systems evaluations
  - SOTIF evaluations

Questions??